



PAPER-I

1. Atomic Structure :

- Heisenberg's uncertainty principle Schrodinger wave equation (time independent); Interpretation of wave function, particle in one-dimensional box, quantum numbers, hydrogen atom wave functions; Shapes of s, p and d orbitals.

2. Chemical bonding :

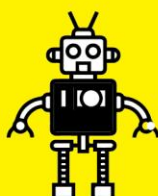
- Ionic bond, characteristics of ionic compounds, lattice energy, Born-Haber cycle; covalent bond and its general characteristics, polarities of bonds in molecules and their dipole moments;
- Valence bond theory, concept of resonance and resonance energy;
- Molecular orbital theory (LCAO method); bonding H_2 , H_2^+ , He_2 + to Ne_2 , NO, CO, HF, CN^- , Comparison of valence bond and molecular orbital theories, bond order, bond strength and bond length.

3. Solid State :

- Crystal systems;
- Designation of crystal faces, lattice structures and unit cell; Bragg's law;
- X-ray diffraction by crystals; Close packing, radius ratio rules, calculation of some limiting radius ratio values; Structures of NaCl, ZnS, CsCl, CaF_2 ;
- Stoichiometric and nonstoichiometric defects, impurity defects, semi-conductors.

4. The Gaseous State and Transport Phenomenon :

- Equation of state for real gases, intermolecular interactions, and critical phenomena and liquefaction of gases;
- Maxwell's distribution of speeds, intermolecular collisions, collisions on the wall and effusion;
- Thermal conductivity and viscosity of ideal gases.



**5. Liquid State :**

- Kelvin equation;
- Surface tension and surface energy, wetting and contact angle, interfacial tension and capillary action.

6. Thermodynamics :

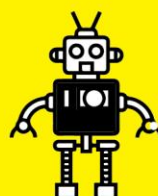
- Work, heat and internal energy;
- First law of thermodynamics. Second law of thermodynamics;
- Entropy as a state function, entropy changes in various processes, entropy-reversibility and irreversibility, Free energy functions;
- Thermodynamic equation of state;
- Maxwell relations;
- Temperature, volume and pressure dependence of U, H, A, G, Cp and Cv, and ; J-T effect and inversion temperature;
- criteria for equilibrium, relation between equilibrium constant and thermodynamic quantities;
- Nernst heat theorem, introductory idea of third law of thermodynamics.

7. Phase Equilibria and Solutions :

- Clausius-Clapeyron equation;
- Phase diagram for a pure substance; phase equilibria in binary systems, partially miscible liquids—upper and lower critical solution temperatures; partial molar quantities, their significance and determination; excess thermodynamic functions and their determination.

8. Electrochemistry :

- Debye-Huckel theory of strong electrolytes and Debye-Huckel limiting Law for various equilibrium and transport properties. Galvanic cells, concentration cells;
- Electrochemical series, measurement of e.m.f. of cells and its applications fuel cells and batteries. Processes at electrodes;





- **Double layer at the interface; rate of charge transfer, current density; overpotential; electroanalytical techniques : amperometry, ion selective electrodes and their use.**

9. Chemical Kinetics:

- **Differential and integral rate equations for zeroth, first, second and fractional order reactions;**
- **Rate equations involving reverse, parallel, consecutive and chain reactions; Branching chain and explosions; effect of temperature and pressure on rate constant.**
- **Study of fast reactions by stop-flow and relaxation methods. Collisions and transition state theories.**

10. Photochemistry:

- **Absorption of light; decay of excited state by different routes; photochemical reactions between hydrogen and halogens and their quantum yields.**

11. Surface Phenomena and Catalysis:

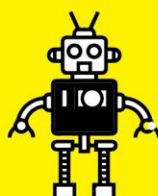
- **Adsorption from gases and solutions on solid adsorbents;**
- **Langmuir and B.E.T. adsorption isotherms; determination of surface area, characteristics and mechanism of reaction on heterogeneous catalysts.**

12. Bio-inorganic Chemistry:

- **Metal ions in biological systems and their role in ion-transport across the membranes (molecular mechanism), oxygen-uptake proteins, cytochromes and ferredoxins.**

13. Coordination Chemistry :

- **Bonding in transition of metal complexes. Valence bond theory, crystal field theory and its modifications; applications of theories in the explanation of magnetism and electronic spectra of metal complexes.**





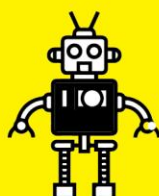
- Isomerism in coordination compounds; IUPAC nomenclature of coordination compounds; stereochemistry of complexes with 4 and 6 coordination numbers; chelate effect and polynuclear complexes; trans effect and its theories; kinetics of substitution reactions in square-planar complexes; thermodynamic and kinetic stability of complexes.
- EAN rule, Synthesis structure and reactivity of metal carbonyls; carboxylate anions, carbonyl hydrides and metal nitrosyl compounds.
- Complexes with aromatic systems, synthesis, structure and bonding in metal olefin complexes, alkyne complexes and cyclopentadienyl complexes; coordinative unsaturation, oxidative addition reactions, insertion reactions, fluxional molecules and their characterization; Compounds with metal—metal bonds and metal atom clusters.

14. Main Group Chemistry:

- Boranes, borazines, phosphazenes and cyclic phosphazene, silicates and silicones, Interhalogen compounds;
- Sulphur—nitrogen compounds, noble gas compounds.

15. General Chemistry of 'f' Block Element: Lanthanides and actinides:

separation, oxidation states, magnetic and spectral properties; lanthanide contraction.

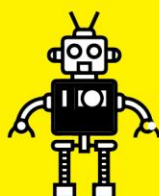


**PAPER-II**

1. **Delocalised Covalent Bonding** : Aromaticity, anti-aromaticity; annulenes, azulenes, tropolones, fulvenes, sydnones.

2. Reactions:

- **Reaction mechanisms** : General methods (both kinetic and non-kinetic) of study of mechanisms or organic reactions : isotopies, method cross-over experiment, intermediate trapping, stereochemistry; energy of activation; thermodynamic control and kinetic control of reactions.
- **Reactive intermediates** : Generation, geometry, stability and reactions of carboniumions and carbanions, free radicals, carbenes, benzyenes and nitrenes.
- **Substitution reactions** :—SN 1, SN 2, and SN i, mechanisms ; neighbouring group participation; electrophilic and nucleophilic reactions of aromatic compounds including heterocyclic compounds—pyrrole, furan, thiophene and indole.
- **Elimination reactions** :—E1, E2 and E1cb mechanisms; orientation in E2 reactions—Saytzeff and Hoffmann; pyrolytic syn elimination—acetate pyrolysis, Chugaev and Cope eliminations.
- **Addition reactions** :—Electrophilic addition to C=C and CC; nucleophilic addition to C=O, CN, conjugated olefins and carbonyls.
- **Reactions and Rearrangements** :—
 - a. Pinacol-pinacolone, Hoffmann, Beckmann, Baeyer-Villiger, Favorskii, Fries, Claisen, Cope, Stevens and Wagner—Meerwein rearrangements.
 - b. Aldol condensation, Claisen condensation, Dieckmann, Perkin, Knoevenagel, Witting, Clemmensen, Wolff-Kishner, Cannizzaro and von Richter reactions; Stobbe, benzoin and acyloin condensations; Fischer indole synthesis, Skraup synthesis, Bischler-Napieralski, Sandmeyer, Reimer-Tiemann and Reformatsky reactions.





3. **Pericyclic reactions** :—Classification and examples; Woodward-Hoffmann rules—electrocyclic reactions, cycloaddition reactions [2+2 and 4+2] and sigmatropic shifts [1, 3; 3, 3 and 1, 5], FMO approach.
4. **Polymers**
 - **Preparation and Properties of Polymers:** Organic polymers polyethylene, polystyrene, polyvinyl chloride, teflon, nylon, terylene, synthetic and natural rubber.
 - **Biopolymers:** Structure of proteins, DNA and RNA.
5. **Synthetic Uses of Reagents:** OsO₄, HIO₄, CrO₃, Pb(OAc)₄, SeO₂, NBS, B₂H₆, Na-Liquid NH₃, LiAlH₄, NaBH₄, n-BuLi, MCPBA.
6. **Photochemistry** :—Photochemical reactions of simple organic compounds, excited and ground states, singlet and triplet states, Norrish-Type I and Type II reactions.
7. **Spectroscopy:** Principle and applications in structure elucidation :
 - **Rotational**—Diatomic molecules; isotopic substitution and rotational constants.
 - **Vibrational**—Diatomic molecules, linear triatomic molecules, specific frequencies of functional groups in polyatomic molecules.
 - **Electronic**—Singlet and triplet states. n and transitions; application to conjugated double bonds and conjugated carbonyls Woodward-Fieser rules; Charge transfer spectra.
 - **Nuclear Magnetic Resonance (1HNMR):** Basic principle; chemical shift and spin-spin interaction and coupling constants.
 - **Mass Spectrometry** :—Parent peak, base peak, metastable peak, McLafferty rearrangement.

